INTERIM REPORT

MACKENZIE RIVER INVESTIGATION

PROPOSED MAJOR DREDGING PROGRAM

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AUG 10 1973

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DEPARTMENT OF PUBLIC WORKS OF CANADA
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MACKENZIE RIVER INVESTIGATION

INTERIM REPORT ON

PROPOSED MAJOR DREDGING PROGRAM

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DEPARTMENT OF PUBLIC WORKS OF CANADA

WESTERN REGION

MACKENZIE RIVER INVESTIGATION

INTERIM REPORT ON

PROPOSED MAJOR DREDGING PROGRAM

1. Objective

The purpose of the Mackenzie River Investigation is to arrive at a definitive cost estimate timing schedules and environmental impact of the overall dredging program proposed on the Mackenzie River by the Northern Transportation Company Limited as required by Treasury Board for their decision criteria.

The purpose of this interim report is to provide a brief report only but of sufficient validity to meet the above requirements.

2. Background

This Department submitted a report on a proposed Mackenzie River Accelerated Dredging Program to Mr. L.R. Montpetit, Vice-President, Northern Transportation Company Limited, on October 23, 1970. The report cautioned that the information presented could be taken as a guide only due to the meager, and in some areas, non-existent data available.

Subsequent to this report the Department of Public Works, at the request in February 1971 of the Transportation Sub-Committee of the Advisory Committee on Northern Development, agreed to assume the chairmanship of the working group responsible for the engineering study of navigation on the Mackenzie River. The first meeting of the working group was held in Ottawa on March 15, 1971. The Group agreed that Public Works should continue to undertake the responsibility for the planning and scheduling of accelerated engineering surveys and investigations. A project manager was appointed for this work on March 31, 1971.

The nature of the study required a multi-discipline approach.

The Department initially referred one parameter of the environmental question to the Fisheries Divsiion of Environment Canada in 1971. To cover a second parameter, the question of water level drawdown on completion of dredging, the Department requested the Ministry of Transport, in March 1972, to undertake this work based on specific Departmental requirements and input. As water level degradation could not be studied without reasonable vertical control the Department approached the Geodetic Service of Canada in May, 1971, to ascertain if they could undertake a vertical control program. This was not possible in 1971. Their survey work commenced in July 1972 and was funded in part by the Department of Public Works.

Subsequently, a "Working Group on the Environmental Consequences of Dredging the Mackenzie River" was set up in September 1972 through the Department of Indian and Northern Affairs. This working group was convened at the request of the Environmental Social Committee of the Task Force on Northern Oil Development. It is believed this "Working Group" now has the responsibility for Environmental Impact studies of dredging on the Mackenzie and Department of Public Works will respond to specific requests rather than determining and actioning any required studies on our own.

3. Scope of Work

A major requirement was the obtaining of factual physical data from which decision criteria and design parameters could be structured. To that end the Department of Public Works engaged in a modified potamology study covering horizontal control, soundings, minor levelling, establishing bench marks for staff gauges, assisting in funding and in setting up automatic water stage recorders, surface current measurements, minor current metering for discharge data, bottom sampling, drilling, boring and sampling, identification of shoreline erosion and accretion, and the determination of low water datums.

As noted in item 2. "Background", Department of Public Works also approached other Agencies concering environmental questions.

Approximately 202 miles of river were sounded over widths varying from 1200' to 2400' and in addition tie-ins were made to aids to navigation for a later guide to Ministry of Transport Marine Services.

4. Priorities and Decision Criteria

.1 Priorities as listed by N.T.C.L. and amended and extended by them in June, 1971 and November 1972. Appendix "A" attached lists the priorities in order of occurrence proceeding downstream.

.2 Channel grade depth 8 ft. to permit a barge draft of 6 ft. proceeding downstream and a tug draft of 5 ft. proceeding upstream.

.3 Channel widths:

(a) Minimum channel width 350 ft.

(b) Channel widths based on criteria set by Dept. of Public Works.

(c) Turns to be widened on the inside of curves proceeding downstream.

(d) Channel widths to permit the operation of a six barge push tow (3 x 2 configuration) 670 ft. long by 170 ft. wide and containing 9,000 to 10,000 tons of cargo from Hay River to the Arctic coastline without relaying.

.4 Production capabilities of private dredging plant to be based on a 20 hour work day and a six day work week over a 15 week production period per season.

.5 Support equipment for all dredges would have to be brought in from the outside as the demands made on the water transport industry to move very large cargo tonnages in the period under consideration would not permit them to rent out floating plant to the dredging industry.

.6 Cutter suction dredges to be of a sufficient size to handle boulders in the 14" range without down time.

.7 Where soils boring show standard penetration tests of 37 blows/ft. or over are general in glacial till dipper or backhoe equipment should be called for.

.8 Suction dredging should be called for from Mile 0 to 28 on the Mackenzie River, with pipeline discharge 2000' from the channel.

.9 Due to the heavy demand on portable dredging equipment for large scale dredging over a relatively short period, full consideration should be given to the future bidding climate in both the N.W.T. and in southern areas of Canada.

.10 An Interim Report should provide the following:

  .1 Estimated quantities of materials to be removed;

  .2 River locations where dredging is required with types of equipment to be utilized;

  .3 Estimated cost of the total program, including engineering costs but not personnel presently on indeterminate staff assignments;

  .4 A time frame for the program;

  .5 Potential maintenance costs and recommendations as to feasibility of maintenance dredging;

  .6 Estimates on potential water level degradation resulting from the proposed dredging program insofar as present data acquisition permits;

  .7 Environmental impact aspects.

  .8 Recommendations on use of Departmental plant for dredging.

5. Low Water Datums

Low Water Datums have been set from Great Slave Lake down to Mi. 673.0 at the Ramparts, within each priority area and at major reference gauging stations along the Mackenzie.

Six temporary automatic gauges were re-established at different locations in the 1973 season to serve as a check on low water datums established in 1972. We anticipate some adjustments to the datums in a few priorities but this should be on the plus rather than the negative side.

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Low water chart datums used in past years at Range Isl., Sta. Bea, and Sta. Point in Beaver Lake, were lowered after analysis for purposes of this investigation. The chart datum in use at the Ft. Providence wharf was raised along with the chart datum of Great Slave Lake.

The low water datum at the automatic Water Survey of Canada gauge site at Dory Point near Fort Providence was lowered while low water datums at W.S.C. gauges at Fort Simpson and Norman Wells were raised.

The Hydrographic and Water Survey people have concurred with these changes.

This investigation did not originally include the Sans Sault Rapids area as dredging contract work was then in progress in response to specific requests of the water transport industry.

As the setting of low water datums proceeded upstream and downstream from Sans Sault it became apparent the chart datum in use at the site should be lowered to conform with the parameters set for the study and long term flow records. A firm final adjustment has not been made to date but an estimate was used for take-off quantities which should be satisfactory for our purposes.

6. Attachments

The following are attached as appendices:

.1 Appendix "A" - A priority listing in order of occurrence proceeding downstream. The listing indicates the river reach, river mileage, estimated dredging quantities, type of equipment required, potential maintenance dredging factor and recommended action.

.2 Appendix "B" - An estimate of cost list outlining the dredging program by sequence of contracts and Departmental dredging plant, showing priorities covered by each contract, quantities, estimated cost, and a bar chart indicating contract award and completion periods.

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.3 Appendix "C" - An estimate of the average volume of maintenance dredging per annum to be expected by priority and river reach.

.4 Appendix "D" - A map of the Mackenzie River District showing the location of a number of the priority areas investigated.

7. Navigational Restrictions

The restrictions to navigation may be generally grouped into the following conditions:

(a) Shallow water; (b) restricted or narrow channel conditions and (c) sharp curvature and cross current problems. All three conditions can be present at any one area. Conditions (b) and (c) of course will limit the width and length of tow and demand a very high degree of both expertise and background knowledge of varying conditions at varying river stages. Condition (a) limits the draft and the tonnage which can be carried by individual barges and river reaches which can be navigated by individual tugs. This latter factor is a real danger to the fleet when returning in the fall to port for winter lay up. It is possible to very slowly navigate tortuous channels but if the depth is not there the tug can be trapped to be caught in the formation of river ice.

It is considered the river reach from Mi. 0 to Mi. 205 (Ft. Simpson) is generally more serious restricted by condition (a) than the other conditions. The river stages in this reach is governed only by Great Slave Lake. As in any one season the Lake has a very limited stage range a low water condition at the start of the season will seriously restrict navigation throughout the entire season.

Priority 20 - Sans Sault Rapids, and Priorty 21 - Ramparts have all three conditions present, while Priority 22 - Norman Wells is restricted by condition (a) plus an exposure hazard.

McGern Island, Priority 33A, was given a low priority by N.T.C.L. It is suggested the conditions here would warrant a much higher priority to say Priority 23 or 24. In 1971 low water conditions occurred in the fall below Fort Simpson. The river stage in

early October was slightly a foot over the navigation low water stage and river traffic was unable to navigate the up to then accepted navigation track east of McGern Island. M.O.T. buoy boats found a very narrow channel available on the west side which allowed passage of the fleet. Our subsequent investigation indicates a river stage 0.5' lower would have blocked passage of a good part of the fleet and if it had gone to low water datum most of the tugs would have grounded out on hard bottom.

8. Channel Alignments

When setting channel widths, curvature and alignment consideration was given to navigation conditions, both upstream and downstream, from the specific location given by N.T.C.L. In some cases we found it necessary to increase the coverage.

The problems which can arise in not examining the overall areas is magnified in the difficult navigational area of the Sans Sault Rapids.

At this latter location D.P.W. carried out dredging at specific locations specified by the water transport industry at various times and to increasing requirements of the water transport industry at the specific request of the industry. We were not requested to provide funds for a pre-engineering investigation of the entire rapids area and it was understood the industry felt that dredging at their specified locations would solve the navigation problems.

This investigation did not originally include Sans Sault Rapids as a dredging contract was then underway. Since that time other problem areas in Sans Sault have come to light with the result that D.P.W. felt an overall review of the entire area was warranted before any further dredging is carried out.

9. Water Level Degradation

The Phase I report to D.P.W. by M.O.T. indicates that dredging from Mi. 0 to Fort Providence would result in a maximum drawdown of only 0.1 on Great Slave Lake. While this would affect our low water datums in Beaver Lake and near Fort Providence by -0.22' it is considered

negligible in relation to the overall reliability of long term data and in any case could be compensated for by minor causeway work near Mi. 3.0.

The dredging from Mi. 42 to Mi. 203 would also have a neglible effect on water drawdown - in the order of 0.1.

Due to lack of vertical control beyond Mi. 240 in 1972 by the Geodetic Service firm studies of the river reaches below Fort Simpson will not be possible until late fall 1973. We expect however, and this is concurred in by M.O.T., that dredging downstream from Fort Simpson will have the same level of impact on water levels as the dredging upstream from Fort Simpson.

We therefore feel the dredging program as proposed will not have a significant effect on future water levels.

10. Environmental Impact

The Fisheries Division of Environment Canada have suggested certain restrictions to dredging from Mi. 0-28 (Beaver Lake) which will not impose a serious economic burden on the dredging program.

The only area of concern down to Fort Simpson at Mi. 205 outside of Beaver Lake is Mills Lake, and I believe this concern relates principally to wildlife. However, the dredging here at Priority 12, Mi. 78.0-82.0 is relatively small - 124,000 cu. yds., with a cut of only 2 ft. As the lake at this point is wide, disposal by pipeline within 2,000' of the channel would not intrude on marsh or bird nesting areas.

This priority has been selected for dredging by Departmental plant which permits a degree of flexibility of operations without heavy financial penalities which could arise if contract dredging was utilized.

Below Fort Simpson the Fisheries people believe that turbidity conditions resulting from dredging would be small in relation to natural conditions. Isolated areas will no doubt be found where spoiling of material must be prohibited but they are not expected to be extensive or significantly affect the dredging program.

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We, therefore, feel the dredging program as an aid to the movement of cargo will have a minimal overall affect on the environment both from the consideration of pollution from dredging and pollution from industry using the waterway.

11. Maintenance Dredging

The maintenance dredging factor indicated in Appendix "A" and the quantities shown in Appendix "C" are basically a value judgement made from our experience on the River and an over view examination of each priority site.

Sedimentation data of any great extent is still not available. Empirical mathematical models would require much more extensive field work at each site than time and funds permit at this time. In any case the reliability of such models is open to question without the use of physical models. Even in the latter case detailed site investigations and experience are preferred.

D.P.W. carried out dredging at Mi. 18 in Beaver Lake in 1959-60. Soundings in 1973 show this channel has had very little fill-in and consequently we feel an allowance of total fill-in of once in 30 years is realistic.

The estimates of 1 in 7 years is based on value judgements from our survey plans and track soundings by the Hydrographic Service in 1964 and again in 1971 or 1972 where large changes are not evident.

Priority 30A McGern Island, is estimated at 1 in 10 years although most of the dredging is in glacial till and the river flow is well channeled. Most infilling will occur at the downstream end where the east and west channels close together through islands.

Priority 22, Norman Wells, is considered a relatively high maintenance area as the channel alignment must be made at an angle to the flow and high steep wave action can occur from time to time.

In the long term many bifurcation areas will lend themselves to relatively minor inexpensive engineered structures such as small submerged weirs to channel flows at lower stages.

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Heavy current channeled through rapids areas is expected to maintain channels dredged through dense glacial till.

This "old" river bottom of glacial till surprisingly shows up in a number of areas below Fort Simpson. These are Priority 33A - McGern Island West, Priority 30E - Fort Norman (just below 1'-4' of overburden), Priority 22 - Norman Wells (shale and till just below 1'-4' of overburden), and Priority 24A - Rader Island, where a medium dense till is exposed. Shale is exposed at Priority 20 - Sans Sault Rapids and limestone at Priority 21 - Ramparts. It provides an indication that the River has maintained a relatively constant river bottom over the long term.

The dredging called for under this program generally involves cuts to grade of only 1' to 4' in general alignment with the stream with an occasional heavy cut of 6'-7' on corners. As shallow dredging does not involve radical changes in the bottom profile we can expect little change from existing conditions and medium or below in-filling.

We have felt that Priority 31C - Cameron Point, Priority 27 - Blackwater River, and Priority 28A - Dahadinni River should not be proceeded with without further checking due to expected high maintenance dredging combined with low priorities. In the case of Priority 27 an alternative deeper channel, although of sharp curvature, is available

Consequently, Priority 31C, 27 and 28A have not been included in the cost estimates.

As maintenance dredging is of necessity a flexible operation we are recommending it be carried out by Departmental plant exclusively. A contractor's plant may be necessary to be brought in once in 15 years to clear out a specific area that has fully filled in.

Maintenance dredging costs, including engineering, in the order of $1,100,000/annum could be expected after the completion of the capital dredging program.

12. Departmental Plant

Appendix "B" shows the program envisaged for the existing Departmental cutter suction dredges No. 224 and 253 and a new dredge. No. 253 would be used on the maintenance dredging in the east channel at Hay River and as a standby.

We are recommending that a new 16" Cutter Suction be purchased to replace the Departmental dipper dredge No. 251, lost at Sans Sault Rapids. This new dredge, as noted, would have a significant role in the capital dredging program and would carry approximately 2/3 of the burden of the maintenance dredging program.

As the work required will be primarily maintenance a suction dredge is preferred for high capacity. The dredge and its pipeline should be capable of working in fast water. It must also have some capability of dredging minor areas of hard material and to that end should have an extra heavy ladder and a high H.P. on the cutter - say in the 200 to 300 H.P. range. The cost of this unit with its housebarge is estimated at $1,300,000.

13. Estimates of Costs

The cost estimates shown in Appendix "B" give a rounded total of $27,600,000 for the program not including Priority 31C, 27 and 28A and maintenance dredging of DPW No. 253 at Hay River.

The program has been broken down into three large contracts plus Departmental plant dredging.

Contracts 1 and 3 will require two dipper dredges per contract, with No. 3 requiring drilling and blasting through the ice in winter at Sans Sault Rapids and the ramparts. Contract No. 2 will call for suction dredging Mi. 0-28. Contracts 2 and 3 would not be completed until mid season in year 5 or 1978. Departmental plant dredging would not be completed until the end of year 5 or 1978.

For contract suction dredging we have allowed $1.50/c.y.p.m. plus $250,000 for mobilization and demobilization and allowances for inspection and dredging alignment aids.

For contract No. 1 we have allowed $3.50/c.y.s.m., $1,325,000 for mobilization and demobilization plus allowances for inspection.

For contract No. 3 we allowed $3.00/c.y.s.m., $15.00/c.y.p.m. for drilling and blasting, $1,600,000 for mobilization and demobilization plus an allowance for inspection.

The survey personnel costs cover only those personnel required to be taken on as term employees for the project.

A completion of the program by year 4 or 1977 would require a further minimum $1,000,000 for additional equipment.

The grand total of $27,600,000 is 5.6 million over our cost category figure of $22,000,000 submitted in July 1972. Since that time we have had to include items for a new dredge, Sans Sault Rapids, increases in quantities unknown in 1972, and costs escalating more than anticipated.

14. Conclusions

.1 A dredging program on the Mackenzie River is viable from an engineering standpoint.

.2 The program should extend over a five year period with the higher priority areas completed by the fall of year 4 or 1977. The exception to this would be Priority 8, Beaver Lake, and Priority 21, the Ramparts, which would not be completed until mid season of year 5 or 1978.

.3 A four year program would cost an estimated additional minimum of $1,000,000 and would raise severe problems with engineering survey control on contracts.

.4 A five year program will cost $27,600,000 including the capital cost of a new dredge with ancillary equipment and inspection and engineering.

.5 Maintenance dredging costs will run in the order of $1,100,000 annually including the cost of contract dredging once every 15 years.

.6 It is strongly recommended that maintenance dredging should primarily be carried out by Departmental floating plant. To that end a new 16" cutter suction should be constructed at a cost of $1,300,000 including ancillary equipment.

.7 Departmental plant with the proposed new dredge can carry out a significant part of the capital dredging program with some modifications to Dredge No. 224 for fast water conditions.

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.8 Three areas of low priority and with anticipated high maintenance should not be considered unless checking at a later date, when the program is underway, shows they will not become problem areas.

.9 Priority 34, Kittigazuit Bay, should not be considered at this time as it is of very low priority and the use of tides is possible when low cargo tonnages of approximately 70,000 tons per annum are being handled.

APPENDIX "A"

MACKENZIE RIVER INVESTIGATION

PRIORITIES WITH DREDGING QUANTITIES

LISTINGS IN ORDER OF OCCURRENCE PROCEEDING DOWNSTREAM

Priority No.	River Reach	Mileage	Local Description	Estimated Quantities c.y.p.m.	Type of (1) Equipment	Potential Maintenance Dredging Factor	Recommended Action
10	Hay River	N/A	East Channel	60,000	c.s.	yearly	Substantially completed 1973
	Great Slave Lake to Dory Point						
4		7-13	Matheson-Grassy Isls.	1,600,000	c.s.	1 in 30 yrs.	Proceed
5		0-7	Lobstick-Brabant Isls.				
6		18-20	Beaver Lake				
7		15-16	Beaver Lake				
8		20-28	Beaver Lake				
9		34-35	Beaver Lake	2,000	c,d	1 in 30 yrs.	Proceed
	Providence Rapids Area						
2 & 3		37.0-40.0	Dory Point	136,325	d.	1 in 30 yrs	Proceed

(1) c.s. - hydraulic cutter suction dredge
c. - clamshell dredge
d. - dipper or backhoe dredge
d.b. - drilling & blasting required

MACKENZIE RIVER INVESTIGATION

PRIORITIES WITH DREDGING QUANTITIES

LISTINGS IN ORDER OF OCCURRENCE PROCEEDING DOWNSTREAM

Priority No.	River Reach	Mileage	Local Description	Estimated Quantities c.y.p.m.	Type of (1) Equipment	Potential Maintenance Dredging Factor	Recommended Action
	Ft. Simpson to Blackwater River						
31A		217.0-220.0	Martin River	Nil	-	-	-
31B		234.0-236.0		Nil	-	-	-
31C		259.5-263.0	Cameron Point	35,000	c.s.	1 in 2 yrs	Hold for checking and buoying.
32(31D)		285.5-287	Camsell Bend	Nil	-	-	-
33A		305.0-323.0	McGern Island West	376,000	d.,c.	1 in 10 yrs	Proceed
33B		336.5-340.5	Old Fort Island	Nil	-	-	-
33C		343.0-346.5	Fish Trap Creek	11,000	c.s., c.	1 in 10 yrs	Proceed
33D		349.5-350.5	Smith Creek	Nil	-	-	-
33E		369.5-370.5	Willow Creek	Nil	-	-	-
33F		397.0-399.0	Johnson River	Nil	-	-	-

(1) c.s. - hydraulic cutter suction dredge
c. - clamshell dredge
d. - dipper or backhoe dredge
d.b. - drilling & blasting required

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APPENDIX "A"

MACKENZIE RIVER [illegible]

PRIORITIES WITH DREDGING QUANTITIES

LISTINGS IN ORDER OF OCCURRENCE PROCEEDING DOWNSTREAM

Priority No.	River Reach	Mileage	Local Description	Estimated Quantities c.y.p.m.	Type of (1) Equipment	Potential Maintenance Dredging Factor	Recommended Action
	Blackwater River to Fort Norman						
27		413.0-415.0	Blackwater River	66,000	c.s., c.	1 in 3 yrs	Hold for checking
28A		422.5-424.5	Dahadinni River	433,000	c.s., c.	1 in 3 yrs	Hold for checking
28B		427.0-428.5	Birch Island	Nil	-	-	-
28C		429.5-433.0	Birch Island	75,000	c.s., c.	1 in 7 yrs	Proceed
29		438.5-442.5	Redstone River	284,000	c.s., c.	1 in 7 yrs	Proceed
30A		449.0-451.0	Saline Island	124,000	c.s., c.	1 in 7 yrs	Proceed
30B		455.0-456.0	Keele River	Nil	-	-	-
30B1		458.0		5,000	c.s., c.	1 in 7 yrs	Proceed
30B2		460.0		5,000	c.s., c.	1 in 7 yrs	Proceed
30C		461.0-464.0		Nil	-	-	-
30D		464.5-465.5		Nil	-	-	-
30E		512.5-513.5	Fort Norman	279,000	c.s., c.	1 in 7 yrs	Check for better channel.

(1) c.s. - hydraulic cutter suction dredge
c. - clamshell dredge

MACKENZIE RIVER INVESTIGATION

PRIORITIES WITH DREDGING QUANTITIES

LISTINGS IN ORDER OF OCCURRENCE PROCEEDING DOWNSTREAM

Priority No.	River Reach	Mileage	Local Description	Estimated Quantities c.y.p.m.	Type of (1) Equipment	Potential Maintenance Dredging Factor	Recommended Action
	Fort Norman to Fort Good Hope						
23A		520.0-525.0	Little Bear River	Nil	-	-	-
23B		529.0-530.0	Slater River	8,000	c.s., c.	1 in 7 yrs	Proceed
23C		541.0-543.0	Prohibition Creek	Nil	-	-	-
23D		547.5-550.0	Ten Mile Island	Nil	-	-	-
22		563.0	Norman Wells	370,000	c.s., c.	1 in 5 yrs	Proceed
24A		569.0-573.0	Rader Island	205,000	c.s., d.	1 in 7 yrs	Proceed
24B		577 ±		Nil	-	-	-
24C		580.0-592.0	Ogilvie & Judith Isls.	Nil	-	-	-
24D		600.0-603.0	Trapper Creek	Nil	-	-	-
24E		607.0-611.0	Svenson Island	Nil	-	-	-

(1) c.s. - hydraulic cutter suction dredge
c. - clamshell dredge
d. - dipper or backhoe dredge
d.b. - drilling & blasting required

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MACKENZIE RIVER NAVIGATION

PRIORITIES WITH DREDGING QUANTITIES

LISTINGS IN ORDER OF OCCURRENCE PROCEEDING DOWNSTREAM

Priority No.	River Reach	Mileage	Local Description	Estimated Quantities c.y.p.m.	Type of (1) Equipment	Potential Maintenance Dredging Factor	Recommended Action
	Fort Norman to Fort Good Hope (Cont'd.)						
20		631.5-635.0	Sans Sault Rapids	306,000	d., b.	1 in 30 yrs	Proceed
25		640.0-642.0		43,000	c.s., c.	1 in 7 yrs	Proceed
26		663.0-665.5		15,000	c.s., c.	1 in 7 yrs	Proceed
21		668.0-673.5	Ramparts	200,000	d., b.	1 in 30 yrs	Proceed
34	Mackenzie Delta Kitti Channel	1065-1070	Kittigazuit Bay	Not investigated due to low priority and use of tides by navigation			

(1) c.s. - hydraulic cutter suction dredge
c. - clamshell dredge
d. - dipper or backhoe dredge
d.b. - drilling & blasting required

APPENDIX "B"

LEGEND:
Contract award to work start ├---┤
Work start to completion ├—┤

MACKENZIE RIVER

PROPOSED MAJOR DREDGING PROGRAM

ESTIMATE OF COST

Dredge or Contract No.	Includes Priorities	Total Estimated Yardage C.Y.	Estimated Cost	1974	1975	1976	1977	1978	Type
#1	1,2,3,9,1B,11,15,16, 17,18,19 & 33A	1,063,000 s.m.	$5,300,000	├--- —	—	—	—┤		Dipper
#2	4 - 8	1,600,000 p.m.	$2,875,000	├---┼	—	—	—	—┤	Suction
#3	24A, 20 & 21	1,095,000 s.m.	$13,650,000		├---┼	— —	— —	—┤	Dipper, & drilling & blasting
	Sub-total (Contract)	3,758,000	$21,825,000						
PWD 224	12,12A,13 & 14B	132,000 p.m.)		├—┤	├—┤				Suction
PWD 224	Pr. 30 E	279,000 p.m.)			├—	—┤			Suction
PWD New	Pr. 22	370,000 p.m.)	2,834,000		├—	—┤			Suction
PWD 224 &) PWD New)	33C,28C,29,30A,30B1 30B2,23B,25 & 26	495,000 p.m.)					├—	—┤	Suction
PWD 253	Pr. 10 - Maintenance + Standby			├—	—	—	—	—	Suction Maintenance
	Sub-total (Dept'l Plant)	1,276,000	$ 2,834,000						
	TOTALS (Contract and Dept'l Plant)	5,034,000	$24,659,000						

New 16" Suction Dredge	$950,000
New Housebarge	$350,000
Survey Vessel Opt. - $90,000/ann. (5 yrs)	$450,000
Survey Personnel, Supplies, etc., $150,000/ann.(5 yrs)	$750,000
Operation of Survey Houseboat, $20,000/ann. (5 yrs)	$100,000
Acquisition of Equipment for Dredges (5 yrs)	$250,000
GRAND TOTAL	$27,600,000 rounded

APPENDIX "C"

MACKENZIE RIVER

MAINTENANCE DREDGING

ESTIMATE

Average Volume Per Annum

River Reach	Average Quantity c.y.p.m./annum	
Great Slave Lake - Ft. Simpson		
Mi. 0 - Mi. 205 Priorities		
10	25,000	
4 - 9	53,400	
1,2,3,1B,11, & 12	13,341	
13 & 14B	43	
15, 16, 17, 18, & 19	7,712	
Sub Total	99,496	99,496
Ft. Simpson - Blackwater River		
Mi. 205 - Mi. 411 Priorities		
33A	37,600	
33C	1,100	
Sub Total	38,700	38,700
Blackwater River - Fort Norman		
Mi. 411 - Mi. 512 Priorities		
28C	10,715	
29	40,571	
30A	17,715	
30B1	715	
30B2	715	
30E	39,857	
Sub Total	110,288	110,288

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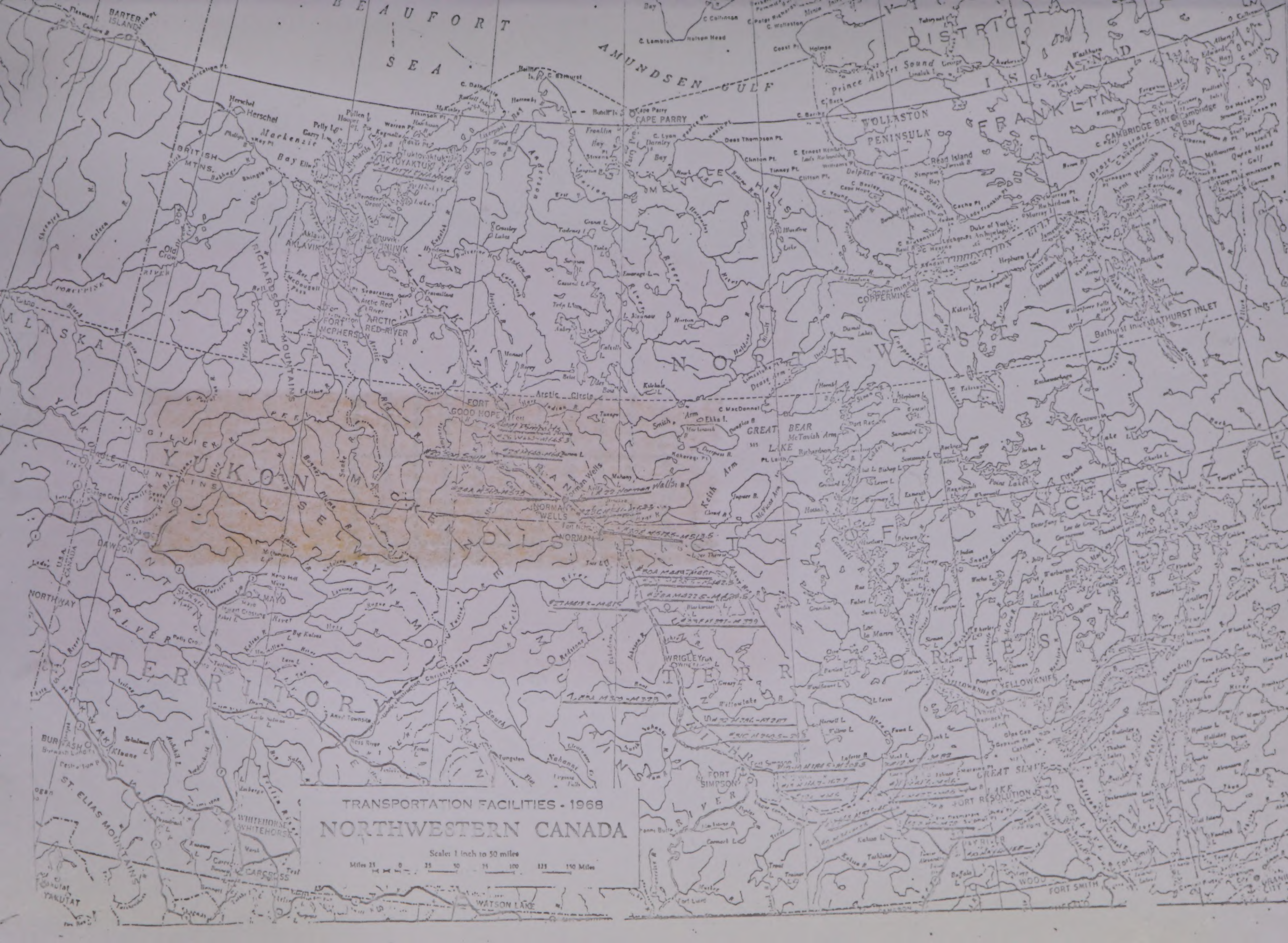
River Reach	Average Quantity c.y.p.m./annum	
Fort Norman - Ramparts		
Mi. 512 - Mi. 673 Priorities		
23B	1,145	
22	74,000	
24A	29,286	
20	12,200	
25	6,143	
26	2,143	
21	6,666	
Sub Total	131,583	
GRAND TOTAL		380,067

Allow 400,000 c.y.p.m./annum average
If priority 31C, Cameron Point, priority 27, Blackwater River, and priority 28A, Dahadinni River, should be proceeded with as is an amount of 184,000 c.y.p.m. would be added to the above average to give 584,000 c.y.p.m./annum average.


TRANSPORTATION FACILITIES - 1968

NORTHWESTERN CANADA

Scale: 1 inch to 50 miles

Date Due

MAR 12 '85

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FORBES, C.D.
AUTHOR

Mackenzie River investigation

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